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Quantifying Electron Spin Polarization from Polarized EL in Si spin-LEDs G. KIOSEOGLOU, University of Crete, P. LI, H. DERY, University of Rochester, A.T. HANBICKI, C.H. LI, O.M.J. VAN 'T ERVE, P.E. THOMPSON, B.T. JONKER, NRL — We analyze the circular polarization (P_{circ}) of the electroluminescence (EL) from Si-based spin-LEDs using a recent theory [1] which provides a quantitative relation between the polarization of phonon-assisted optical transitions measured in the EL, and the electron spin polarization electrically injected from Fe/Al2O3 and Fe/SiO2 tunnel barrier contacts [2,3]. EL spectra include features due to transverse acoustic (TA) and transverse optical (TO) phonon-mediated recombination occurring in the p-doped (p$\sim 10^{19}$cm-3) substrate. P_{circ} of 3.5% is typical for the TA at 5K, and is systematically higher than that of the TO by a factor $\sim$1.7, consistent with theory. The maximum polarization predicted for the TA is 13% for recombination of 100% polarized electrons in p-type Si (10^{19}cm-3). Thus the measured P_{circ} 3.5% corresponds to an electron spin polarization (P_{spin}) of 27% produced by electrical injection from our tunnel barrier contacts. A similar analysis applied to the TO phonon at 80K yields P_{spin} of 25%. Thus the theory enables quantitative interpretation of optical polarization in indirect gap semiconductors, facilitating future studies of spin injection. [1] P. Li and H. Dery, Phys. Rev. Lett. 105, 037204 (2010). [2] B.T. Jonker, et al., Nature Physics 3, 542 (2007). [3] C.H. Li, et al, Appl. Phys. Lett. 95, 172102 (2009).

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